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created the great fabric of modern language. In some respects the undertaking necessarily bore the impression of being fragmentary, and the majority of readers will be more pleased with the present second volume, which is a systematic and connected story of the development.

The author has had the advantage of the material gathered in Engelmann's series of *Scientific Classics*, and he has consciously exploited this fund to the fullest extent. Reproductions of original instruments and apparatus, of original diagrams and illustrations, which could otherwise have hardly been obtained, are strewn throughout the work, and greatly enhance its attractiveness and worth. Thus, for example, there are reproductions of the picture of the human muscular system given in the great work of Vesalius, printed in 1543; the telescopes and astronomical diagrams given in the works of Kepler; pictures of Gilbert's celebrated work *On the Magnet*; Tycho Brahé's quaint azimuth quadrant; the electrical machine and air-pumps of Guericke; Huygens's clocks; Leeuwenhoek's illustrations of human tissues; Ledermüller's illustrations of infusoria; the first electric pile of Volta; Hauy's dodeckahedra; and the plate of the spectrum analysis first published by Kirchhoff and Bunsen, in 1860; etc., etc.

Dr. Dannemann has not slurred antiquity, and has given a much more appreciative estimate of the achievements of the ancients than is generally found in works of this character. He has not omitted to emphasise the consideration of the social and religious factors which have influenced science, and in many cases has well characterised the constant struggle for existence among ideas which has been a distinguishing mark of the development of modern knowledge. Mechanics, physics in all its branches, chemistry, astronomy, zoölogy, botany, and biology, come successively under his ken. The presentation generally is continuous and pleasing, and the author is to be congratulated upon the successful issue of his task. The book is one which fills a real want, and should be welcomed by all instructors of science.

T. J. McC.

PRISMATIC AND DIFFRACTION SPECTRA. Memoirs by *Joseph von Fraunhofer*. Translated and edited by J. S. Ames, Ph. D., Professor of Physics in Johns Hopkins University. New York and London: Harper & Brothers. 1898. Pp., 68. Price, 60 cents.

THE FREE EXPANSION OF GASES. Memoirs by Gay-Lussac, Joule, and Joule and Thomson. Translated and edited by J. S. Ames. New York and London: Harper & Brothers. 1898. Pp., 106. Price, 75 cents.

It was inevitable that some English or American scientist should have been led to follow the example of Professor Ostwald, of Leipsic, in the publication of a series of Scientific Classics, and it is well that the work should have fallen into such good hands as those of the present editor and publishers. The new English series is termed "Harper's Scientific Memoirs," and will be similar in contents to the

German series published by Engelmann, of Leipsic. Nevertheless, it is not a slavish imitation of its prototype, but in many respects embodies real improvements over its predecessors. The selection of memoirs is not entirely the same, and it seems likely that, for the present at least, it will be limited to physics. The editor is Dr. J. S. Ames, professor of physics in Johns Hopkins University, the associate of Rowland, the author of an excellent text-book on the *Theory of Physics*, and an independent inquirer of merit. Professor Ames has edited and translated the first two volumes of the series, the names of which are given at the head of our review; he has supplied prefaces characterising the scientific importance of these two memoirs, has in each case added helpful bibliographies, and has made indexes, something which is never found in a German book.

The historical importance of the first volume, which is made up of the memoirs of Fraunhofer on prismatic and diffraction spectra, may be best seen by a glance at the history of the subject. The spectrum of the sun which Newton first observed in 1666 through a small round opening in a shutter was impure. Wollaston, whose memoir is also printed in the first volume, was the first (1802) to obtain a pure spectrum, in which he observed *several dark lines*, which he interpreted as the demarkations of the spectral colors. In 1814, Fraunhofer independently discovered these lines, which in all physics now bear his name. Like Wollaston, he also at first used a slit and prism; but his most important discovery was that the same phenomena could be obtained *by means of gratings made up of wires or ruled on glass.* The interpretation of the physical meaning of the Fraunhofer lines was reserved for the genius of Kirchhoff.

The "great merit" of the memoirs of Fraunhofer here reproduced is characterised by the editor as "the systematic and logical method by which he proceeds from investigation to investigation." And it is to be noted that the choice of these memoirs as the initial number of the new American series of scientific classics has a peculiar significance through the fact that in this country to-day, and at Johns Hopkins University, the finest diffraction-gratings in the world are made, and that at that university the researches which took their origin in Fraunhofer's investigations have been pushed through Professor Rowland to their highest consequences. The general importance of the American contributions to this subject can be clearly seen by a glance at the bibliography given in the book.

The second number of the series is that on the free expansion of gases, being the memoirs of Gay-Lussac, Joule, and Thomson. They form part of that magnificent scientific development of the nineteenth century which constituted the foundation of the doctrine of the conservation of energy and its extension into the science of thermodynamics. Most of these essays are not generally accessible to scientific students, and it must be regarded as nothing less than a boon that they have now been placed within easy reach. The Memoirs will be especially valuable to students of the philosophy of science. It is here that science can be seen in its making, and the stimulus which comes from contact with the great minds of its founders cannot be overrated. We hope to mention the succeeding numbers of the series as they appear.

T. J. McC.

LECTURES ON THE GEOMETRY OF POSITION. By *Theodor Reye*, Professor of Mathematics in the University of Strassburg. Translated and edited by Thomas F. Holgate, M. A., Ph. D., Professor of Applied Mathematics in Northwestern University. Part I. New York: The Macmillan Company. 1898. Pp., 248+xix.

Reye's *Geometrie der Lage* has long been a celebrated book in the English-speaking world, and has been made the foundation of many English expositions of the subject, notably that of Professor Henrici in the *Encyclopædia Britannica*. But it was not until last year that the work could be consulted by students ignorant of German. This was made possible by the translation of Professor Holgate, who deserves the thanks of all students of pure geometry for his laborious task.

Modern synthetic geometry is mainly a development of the nineteenth century. Prior to that time, and particularly in antiquity, geometrical discoveries, while important, were largely of a fragmentary and disjointed character, and not connected by systems of general principles; and, if we except the method of analysis attributed by Pappus to Plato, there was no general system of procedure by which new discoveries could be made possible. It was precisely this defect that lead Descartes to substitute for the ancient methods that powerful instrument of discovery called analytical geometry, which evolved new truths by sheer mechanical procedures alone, and which, by its great success, diverted the minds of philosophers and scientists for nearly two centuries from investigations in pure geometry proper. The new movement began with Monge's work on *Descriptive Geometry* and Poncelet's *Treatise on the Projective Properties of Figures* (1822), in which last work the principles of continuity and reciprocity and the method of projection were used. The successors of these great inquirers were Steiner, Chasles, Von Staudt, and two living authors,—Reye and Cremona.

The real distinction between the old and the new geometry, as represented by the names last mentioned, can be summed up in the fact that while the former was almost entirely metrical, the latter is almost purely positional. For example, in the old geometry we constantly deal with such things as the bisection of segments of straight lines, with right angles and perpendiculars, with ratios, proportions, the computation of areas, and, in its subsequent development, with trigonometric ratios and the algebraic equations of curved lines, all of which involve the idea of measurement. But in pure geometry nothing of this kind is introduced, although its results admit of metrical application. There is no talk of isosceles or equilateral or right-angled triangles, rectangles, regular polygons, etc. The centres, axes, and foci of conic sections "are considered as incidental only to the general theory; but, on the other hand, we are made acquainted with properties of these curves which are more general and more important than those to which most text-books of ana-